PermiAM: Engineered Porosity In-Situ with Fully Dense AM Structure, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

This work answers the questions and needs of Focus Area 21 Subtopic Z9.01 for small launch vehicle technologies by providing affordable launch architecture, as propulsion systems are the highest cost subsystem for rocket development and PermiAM will enable a large savings for main propulsion system engine development. Part of the work performed in this SBIR will help in determine the potential savings for future engine development programs, currently projected at 10x for injector build cost savings which require face cooling. PermiAM will enable increased design simplicity for AM injectors and reduced development costs through improved face cooling and improved combustion stability. A full scale proof of concept ground test will be demonstrated by the end of Phase II, with the subscale demonstration during Phase I to meet the subtopic requirements.

Anticipated Benefits

PermiAM material is aligned with NASA Technology Roadmap needs TA1.2, TA2.1, and TA12. Masten is currently focusing on the propulsion elements of PermiAM with direct applicability to small satellite launch vehicles, upper stage engines, and planetary landers. For SLS, the RS-25 and RL10 use a coaxial injector with Rigimesh face. As AM build volumes increase it will be possible to replace the expensive and complex rigimesh injector with an AM version to lower the cost of heavy lift space access.

For aviation it may be used to improve the performance and reliability of commercial jet engines. Current jet engine combustion chamber designs use bypass air and baffles to keep instabilities under control and prevent the walls from overheating. PermiAM would allow the more even application of cooling air, better boundary layer performance, and reduce instabilities. Masten would also explore markets in rocketry and is open to license PermiAM to other rocket engine manufacturers.

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Table of Contents

Small Business Innovation Research/Small Business Tech Transfer

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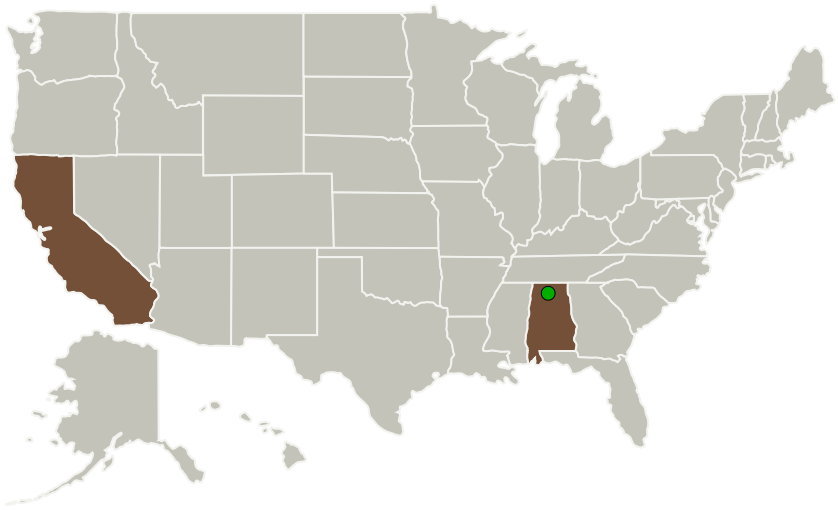
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Masten Space Systems, Inc	Lead Organization	Industry	Mojave, California
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	California

Project Transitions

July 2018: Project Start

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141225)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Masten Space Systems, Inc

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

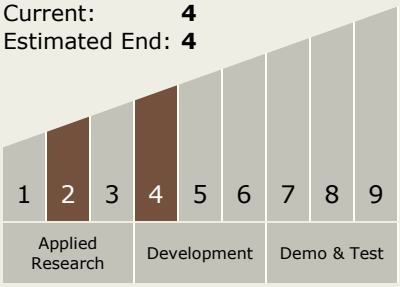
Carlos Torrez

Principal Investigator:

Matthew Kuhns

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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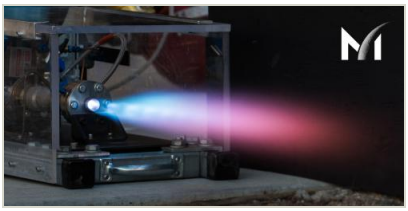
Images

Briefing Chart Image
PermiAM: Engineered Porosity In-Situ with Fully Dense AM Structure, Phase I
(https://techport.nasa.gov/image/134506)



Final Summary Chart Image
PermiAM: Engineered Porosity In-Situ with Fully Dense AM Structure, Phase I
(https://techport.nasa.gov/image/134850)

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.2 Earth Storable

Target Destination

Earth